Docket No. BEAT-005

APPLICATION

FOR UNITED STATES LETTERS PATENT

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT WE, **Douglas L. Hauck**, a citizen of the United States, **David L. Kvidt**, a citizen of the United States, and **Jeff L. Johnson**, a citizen of the United States, have invented a new and useful power line phase coupler system of which the following is a specification:

Power Line Phase Coupler System

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to power line phase couplers and more specifically it relates to a power line phase coupler system for repeating data signals between power line phases that can be easily installed by a user.

Power line communication (PLC) is utilized to connect various electronic devices within a building structure via the electrical power system of the building. Networking of these electronic device may utilize two different but complementary PLC technologies: one for high speed data communication (computer networking, printer sharing, Internet connection, etc.) and one for control applications (designed for the lowest possible cost). Data communication applications have requirements that are completely different from control applications. Regardless of the PLC technology utilized, a home utilizing a multi-phase power line system creates several communication problems for the devices connected to the separate power line phases.

Description of the Prior Art

Electronic devices are commonly utilized in residential and commercial buildings to transmit data signals along the power lines of the building (i.e. power line communications). Most conventional electronic devices are electrically coupled to a single phase of the power lines of the building by simply inserting the male plug of the device into a female receptacle of a wall socket. The data signals are relatively low power signals are transmitted by a transmitter device and received by a receiver device positioned upon the same power line phase to accomplish various tasks such as turning on an appliance or adjusting the temperature within the building. The data signals are typically transmitted at relatively high frequencies typically greater than 1 KHz to reduce interference with the power line frequency of 60 Hz in North America (or 50 Hz elsewhere). LEVITON is one company that manufactures a variety of electronic devices that communicate via a building's power line system (http://www.leviton.com). There are various other manufacturers of power line communication devices such as ACT, Interactive Technologies, Inc. (ITI), Home Automation, Inc. (HAI), and X-10 PRO.

The most commonly utilized power line system within residential buildings in North America is 60 Hz, 120/240-volt split-single phase power. This power line system is basically comprised of two "phases" of power provided by three wires represented by (1) Phase A, (2) Phase B, and (3) Neutral. Phase A and Phase B of the power line system are approximately 180 degrees out of phase with respect to one another. Each of the phases carries approximately 110 to 120 volts of alternating current with respect to the neutral line. Since the phases are 180 degrees out of phase with one another the total voltage between the two phases is 240 volts. U.S. Patent Nos. 5,192,231 and 5,187,865 provide an overview of conventional power line systems.

Since most wall outlets within building structures are "single phase" outlets (i.e. electrically connected to only one phase and ground), the data signal transmitted by the transmitter device is only transmitted along the power line phase electrically coupled to and not the other power line phase. "Natural" coupling for the data signal sometimes occur by passing passively through a phase-to-phase load (e.g. electric 240 volt water heater or stove) or through a transformer. However, consistent and reliable natural coupling is difficult to achieve and typically is not feasible for a reliable system to be implemented. Natural coupling is especially difficult to achieve in larger buildings that have numerous electronic devices connected to power outlets within the building.

To provide adequate communications for the data signal between the two phases of the building, it is often times desirable to "couple" the phases together at the breaker panel. The two most commonly utilized systems of coupling the two phases within a building structure are comprised of (1) passive couplers and (2) repeater couplers.

"Passive" couplers are typically comprised of a capacitor electrically coupled between the two phases at the breaker panel. Passive couplers do not enhance the data signal during bridging between the phases and many times a passive coupler will actually reduce the signal strength of the data signal. Utilizing a passive coupler can be difficult since the capacitor may allow the lower power frequencies and other data signals to undesirably pass between the phases. In addition, coupling the phases together at the breaker panel with a passive coupler can be difficult and dangerous even for skilled professionals. Also, the signal strength of the data signal is weakened after passing through a passive coupler and sometimes cannot be detected by a receiver device. In larger building structures a passive coupler simply is not acceptable to maintain the desirable signal strength of the receiver devices. U.S. Patent Nos. 5,192,231 and 5,187,865 illustrate utilizing a passive coupler system that engages a wall outlet utilizing a capacitor for coupling the two phases but has the same problems as breaker panel passive couplers.

The most reliable type of power line coupler utilized today are "repeater couplers" which are electrically connected between the two phases at the breaker panel. Repeater couplers detect a data signal upon one of the phases. The repeater then amplifies and repeats the detected data signal to the second phase of the power line system. The repeated data signal is "tagged" with an identifier to prevent repeating of the already repeated data signal if received by the repeater coupler again. The LEVITON 6201 system coupler repeater is an exemplary example of a repeater coupler and is incorporated by reference into this application for the purpose of disclosing a suitable repeater coupler. The LEVITON 6201 takes data signals generated on the 120-volt line phase from which the LEVITON 6201 draws power, then boosts the data signals at the zero crossing on the other line phase of a 120/240-volt or any phase of a three-phase 120/208-volt residential wiring network. The LEVITON 6201 is typically installed at the main breaker panel, on its own dedicated 15 amp breaker (per National Electrical Code).

While these devices may be suitable for the particular purpose to which they address, they are not as suitable for repeating data signals between power line phases that can be easily installed by a user. The main problem with passive couplers is that they are not suitable for usage within larger building structures or where numerous electrical devices are connected within. The main problem with conventional repeater couplers is that they are designed to be utilized only within a main breaker panel and are not easy to utilize for most consumers.

In these respects, the power line phase coupler system according to the present invention substantially departs from the conventional concepts and designs of the prior art, and in so doing provides an apparatus primarily developed for the purpose of repeating data signals between power line phases that can be easily installed by a user.

SUMMARY OF THE INVENTION

In view of the foregoing disadvantages inherent in the known types of power line couplers now present in the prior art, the present invention provides a new power line phase coupler system construction wherein the same can be utilized for repeating data signals between power line phases that can be easily installed by a user.

The general purpose of the present invention, which will be described subsequently in greater detail, is to provide a new power line phase coupler system that has many of the advantages of the power line couplers mentioned heretofore and many novel features that result in a new power line phase coupler system which is not anticipated, rendered obvious, suggested, or even implied by any of the prior art power line couplers, either alone or in any combination thereof.

To attain this, the present invention generally comprises a housing, a female connector positioned within the housing, a male connector electrically connected to the female connector by a length of cord, and a repeater coupler electrically connected to the male connector. The repeater coupler is electrically connected between Phase A and Phase B of the male connector for repeating and amplifying a data signal received from either phase to the opposite phase.

There has thus been outlined, rather broadly, the more important features of the invention in order that the detailed description thereof may be better understood, and in order that the present contribution to the art may be better appreciated. There are additional features of the invention that will be described hereinafter and that will form the subject matter of the claims appended hereto.

In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of the description and should not be regarded as limiting.

A primary object of the present invention is to provide a power line phase coupler system that will overcome the shortcomings of the prior art devices.

A second object is to provide a power line phase coupler system for repeating data signals between power line phases that can be easily installed by a user.

Another object is to provide a power line phase coupler system that is not connected to the main breaker panel of a building.

A further object is to provide a power line phase coupler system that can be connected so as to not physically interfere with surrounding electrical appliances.

Another object is to provide a power line phase coupler system that does not require installation by an electrician or other skilled professional.

An additional object is to provide a power line phase coupler system that can be utilized within larger building structures with longer power line systems.

A further object is to provide a power line phase coupler system that can be utilized within buildings with numerous electrical devices connected to the power line system of the building.

Another object is to provide a power line phase coupler system that amplifies and repeats the data signal received by a transmitter device from a first power line phase to a second power line phase at an increased level.

A further object is to provide a power line phase coupler system that increases the overall communication efficiency of power line communication devices.

An additional object is to provide a power line phase coupler system that provides a simple, easy and convenient system to link the entire wiring of a building together for the purposes of providing a network for communication and control of devices electrically connected to the power line system of the building.

Other objects and advantages of the present invention will become obvious to the reader and it is intended that these objects and advantages are within the scope of the present invention.

To the accomplishment of the above and related objects, this invention may be embodied in the form illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that changes may be made in the specific construction illustrated and described within the scope of the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other objects, features and attendant advantages of the present invention will become fully appreciated as the same becomes better understood when considered in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the several views, and wherein:

FIG. 1 is an upper perspective view of the present invention electrically connected to a wall outlet.

FIG. 2 is an upper perspective view of the present invention.

FIG. 3 is an upper perspective view of the present invention with the cover partially removed.

FIG. 4 is a top view of the present invention.

FIG. 5 is a cutaway view taken along line 5-5 of Figure 4 of the drawings.

FIG. 6 is a schematic illustration of the present invention.

FIG. 7 is a schematic illustration of the repeater coupler electrically connected between the two phases of a power line.

FIG. 8 is an upper perspective view of a first embodiment of the present invention.

FIG. 9 is a side view of the first embodiment of the present invention.

FIG. 10 is an upper perspective view of a second embodiment of the present invention.

FIG. 11 is a side view of the second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now descriptively to the drawings, in which similar reference characters denote similar elements throughout the several views, FIGS. 1 through 11 illustrate a power line phase coupler system **10**, which comprises a housing **40**, a female connector **60** positioned within the housing **40**, a male connector **20** electrically connected to the female connector **60** by a length of cord **30**, and a repeater coupler **50** electrically connected to the male connector **20**. The repeater coupler **50** is electrically connected between Phase A and Phase B of the male connector **20** for repeating and amplifying a data signal received from either phase to the opposite phase.

A conventional power line system of a building typically has a Phase A power line, Phase B power line and a neutral line wherein Phase A is 180 degrees out of phase with respect to Phase B. Some power line systems have a four line called the ground line. A conventional wall outlet **12** providing dual-phase power typically has three slots for Phase A, Phase B, and neutral. If ground is utilized, the conventional wall outlet **12** will have a fourth slot within. The conventional wall outlet **12** is then capable of providing 240-volt power to an appliance such as a dryer.

As shown in Figures 1 through 4 of the drawings, the present invention includes a male connector **20** that electrically mates with the wall outlet **12**. The male connector **20** includes a first prong **22**, a second prong **24** and a third prong **26** connectable to Phase A, Phase B and the neutral slots of the wall outlet **12** respectively. If the wall outlet **12** has a ground slot, the male connector **20** can include a fourth prong though not shown in the drawings. The male connector **20** may be comprised of various shapes, structures and configurations depending upon the wall outlet **12**.

The male connector **20** preferably has a flat profile for not interfering with the surrounding electrical appliances as best shown in Figures 1 through 3 of the drawings. A length of power cord **30** is electrically connected to the male connector **20** has includes three or four wires depending upon the number of prongs utilized within the male connector **20**. The cord **30** preferably extends downwardly from the male connector **20** to maintain a flat profile when utilized with the wall outlet **12**. The cord **30** is preferably of sufficient length to allow positioning of the housing **40** in a convenient location for insertion of a power connector from an electrical appliance.

As shown in Figures 1 through 5 of the drawings, the housing **40** has an interior cavity **42** for storing the repeater coupler **50** and various other electrical equipment. The housing **40** preferably has a removable cover **44** that is attachable by a plurality of fasteners **46** as best shown in Figures 2 and 3 of the drawings. Various other connection means may be utilized to secure the cover **44** to the housing **40**. The housing **40** is preferably constructed of a flat structure and may have various shapes and structures.

As shown in Figures 3 and 5 of the drawings, a repeater coupler **50** is positioned within the interior cavity **42** of the housing **40**. The repeater coupler **50** is electrically connected to the power cord **30** opposite of the male connector **20** for allowing coupling of Phase A and Phase B of the power line system of the building structure. The repeater coupler **50** receives power from either of the phases and the neutral line. More specifically, the repeater coupler **50** is electrically connected between the wires of the cord **30** corresponding to Phase A and Phase B of the power line system as best shown in Figure 7 of the drawings.

The repeater coupler **50** is comprised of an amplifier structure that detects a data signal sent along either of the phases within the power line system and then repeats the data signal to the other power line phase at an amplified level. The repeater coupler **50**

does not allow the **60** Hz power signal to pass between the phases, but rather only repeats and amplifies higher frequencies of data signals over 1 KHz.

In addition, the following product is considered relevant to the repeater coupler **50** structure and functionality of the present invention and is incorporated herein by reference: LEVITON 6201 system coupler repeater. The aforementioned product, which is mentioned elsewhere in this disclosure, and which form a part of this disclosure, may be applied in any known manner by those skilled in the art in order to practice various embodiments of the present invention. The following patents are considered relevant to the repeater coupler **50** structure and functionality of the present invention and are incorporated herein by reference: U.S. Patent No. 4,032,911 entitled "Signal Repeater For Power Distribution Line Communication Systems"; U.S. Patent No. 3,973,087 entitled "Signal Repeater For Power Line Access Data System" and U.S. Patent No. 3,911,415 entitled "Distribution Network Power Line Carrier Communication System." The aforementioned patents may be applied in any known manner by those skilled in the art in order to practice various embodiments of the present invention.

A female connector **60** is preferably positioned within the housing **40** as best shown in Figures 1 through 6 of the drawings. It can be appreciated that the female coupler **60** does not have to be utilized within the present invention where the female coupler **60** is not required. The female connector **60** is electrically connected to the three wires within the power cord **30** in parallel to the repeater coupler **50**. The female connector **60** is formed for electrically receiving a power connector from an electrical appliance such as a dryer to allow the electrical power to be transferred from the power line system of the building to the electrical appliance. The female connector **60** includes a first slot **62**, a second slot **64** and a third slot **66** connectable to Phase A, Phase B and the neutral slots of the power cord **30** opposite of the male connector **20** as best shown in Figure 6 of the drawings. The female connector **60** includes a fourth slot if a ground wire is included within the power cord **30**.

As shown in Figures 8 and 9 of the drawings, a first alternative embodiment of the present invention is provided that eliminates the usage of the power cord **30**. The housing **40** for the first alternative embodiment is generally comprised of a tubular structure having opposing ends thereof. The male connector **20** and the female connector **60** at attached to the opposing ends of the tubular housing **40** as best shown in Figure 9 of the drawings. The electrical connections of the male connector **20**, the female connector **60** and the repeater coupler **50** are not changed for the first alternative embodiment as can be appreciated providing the same effect as the main embodiment in a more compact structure.

As shown in Figures 10 and 11 of the drawings, a second alternative embodiment of the present invention is provided that eliminates the usage of the power cord **30** similar to the first alternative embodiment. The housing **40** for the second alternative embodiment is generally comprised of a flat structure having a front surface and a rear surface. The male connector **20** and the female connector **60** at attached to the opposing surfaces of the housing **40** as best shown in Figure 11 of the drawings. The electrical connections of the male connector **20**, the female connector **60** and the repeater coupler **50** are not changed for the second alternative embodiment as can be appreciated providing the same effect as the main embodiment in a more compact structure.

In use, the user electrically connects the male connector **20** to a conventional wall outlet **12** of a building structure wherein the wall outlet **12** is electrically coupled to both Phase A and Phase B of the power line system. If a transmitter device electrically connected to the power line system via another wall outlet **12** transmits a data signal along one of the power line phases, the data signal is then detected by the repeater coupler **50**. The repeater coupler **50** then repeats, amplifies and tags this data signal to the other power line phase to be received by the desired receiver device

electrically connected to that power line phase. An example of this operation is shown in Figure 7 of the drawings. If data signal A enters Phase B of the power line system by a transmitter device, the repeater coupler **50** detects/receives data signal A and then converts data signal A to data signal B that is transmitted to Phase A which is properly received by the receiver device. Signal B is simply an amplified signal A with a "tag" positioned within to prevent repeating a second time.

As to a further discussion of the manner of usage and operation of the present invention, the same should be apparent from the above description. Accordingly, no further discussion relating to the manner of usage and operation will be provided.

With respect to the above description then, it is to be realized that the optimum dimensional relationships for the parts of the invention, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, are deemed to be within the expertise of those skilled in the art, and all equivalent structural variations and relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the present invention.

Therefore, the foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.